



Electric vehicles or use of hydrogen in the Danish transport sector in 2050?

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Electric vehicles or use of hydrogen in the Danish transport sector in 2050?

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TOP NEST workshop - WP2

30 October 2014



Agenda

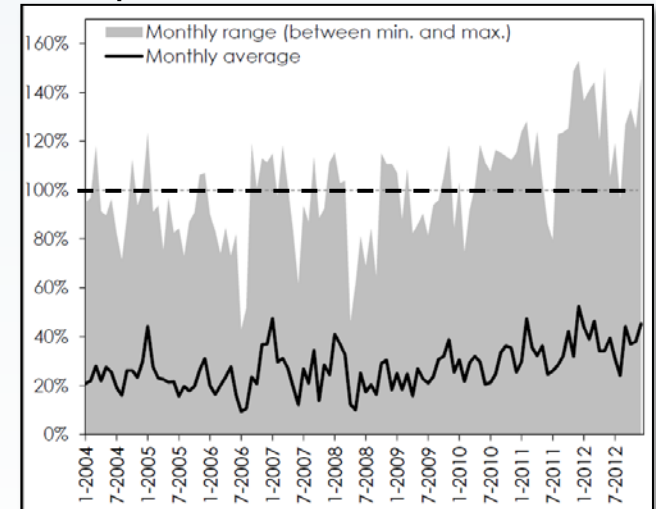
- Research motivation
- STREAM model
- 2050 scenarios
- Scenario results
- Technological path towards the 2050 target?



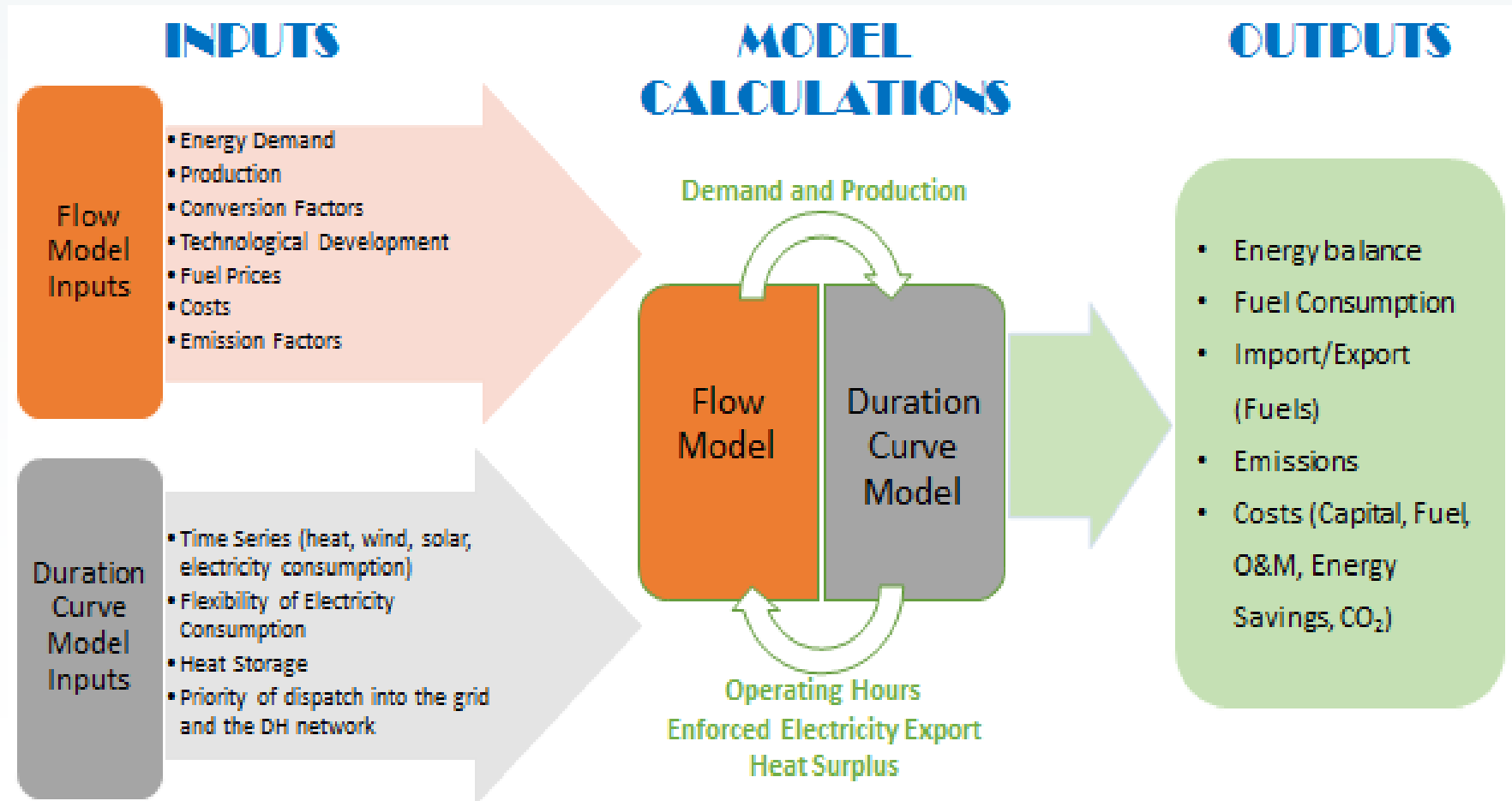
Research motivation

- Political targets in DK:
 - 2035: 100% RES based electricity generation
 - 2050: fossil free energy sector incl transport
- Large share of wind in the power supply
- Limited domestic biomass resources
- Need for a flexible demand
- Radical restructuring of fuel use and vehicle stock
- EV or H2?
 - Which costs?
 - Interaction with the energy sectors?
- Which technological path?
 - Low capital costs? Flexible demand? or high efficiency?

Wind production share in DK-West



STREAM model



Reference - Carbon Neutral Scenario - CNS

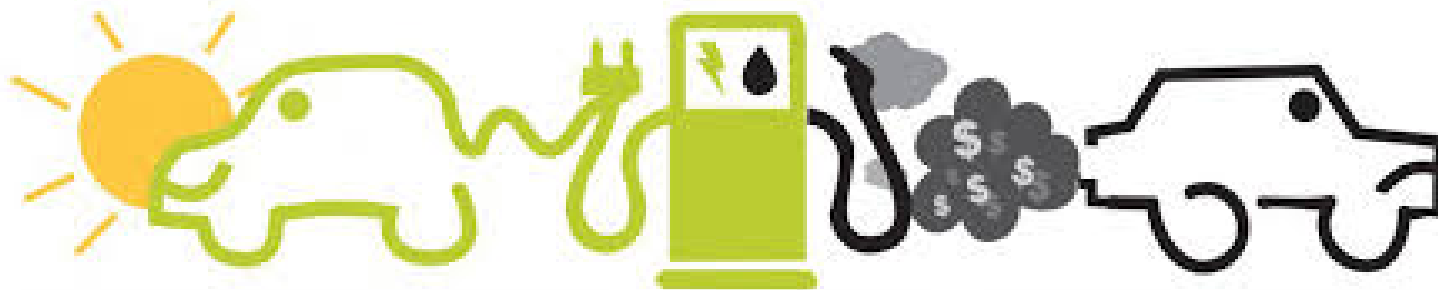
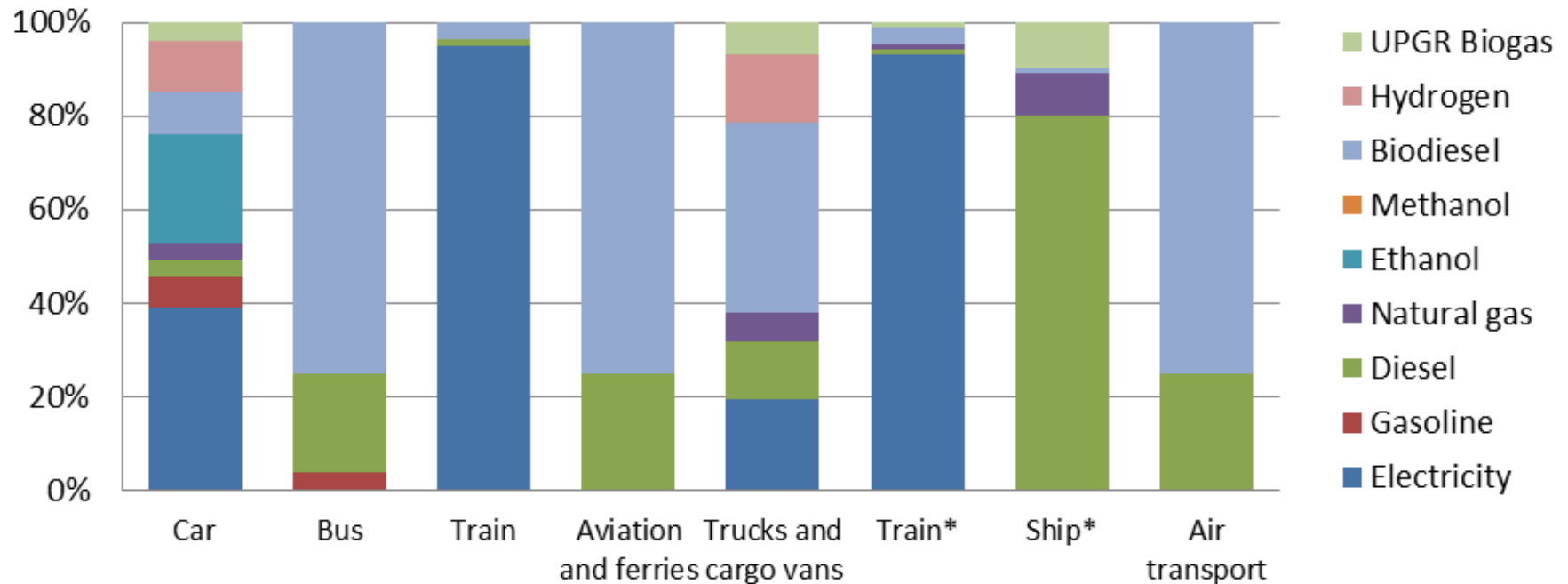
Electricity production			District Heat boiler production		
	2012	CNS 2050		2012	CNS 2050
Coal Plant	57%	0%	Coal boiler	1%	0%
Gasturbine	23%	0%	Natural gas boiler	47%	0%
Wind, offshore	4.3%	56%	Geothermal	2%	0%
Wind, onshore	18%	27%	Heatpump	0%	21%
Biomass	9%	4%	Wood pellet boiler	31%	76%
Biogas	1%	4%	Oil boiler	15%	0%
Waste incineration	7%	5%	Biogas Boiler	1%	1%
Photo voltaic	0%	2%	Municipal waste	3%	3%
Wave power	0%	1%	Electric boiler	1%	0%
Biomass incl. CO2-storage	0%	2%	Solar heat	1%	0%
Demand coverage	118%	100%	Demand coverage	100%	100%
Electricity imports	-18%	0%	Heat import	0%	0%



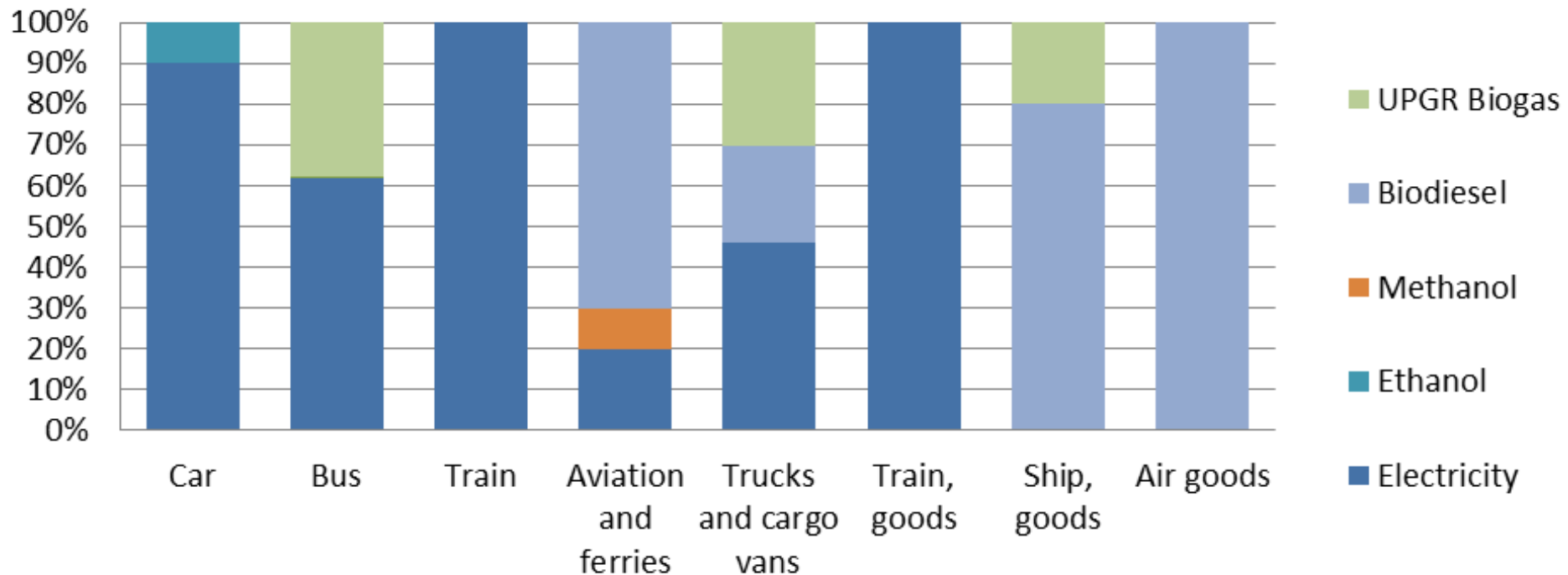
Technology mix in the electricity and heating sectors



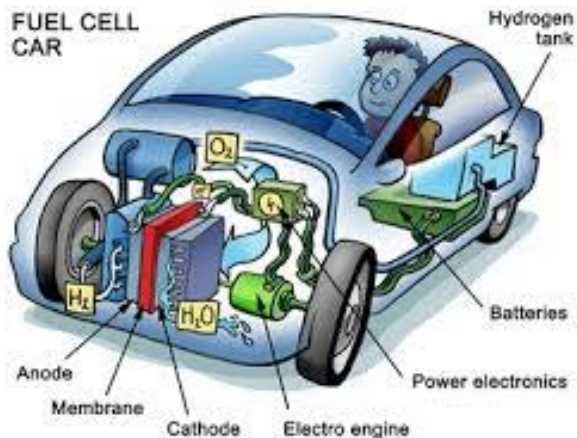
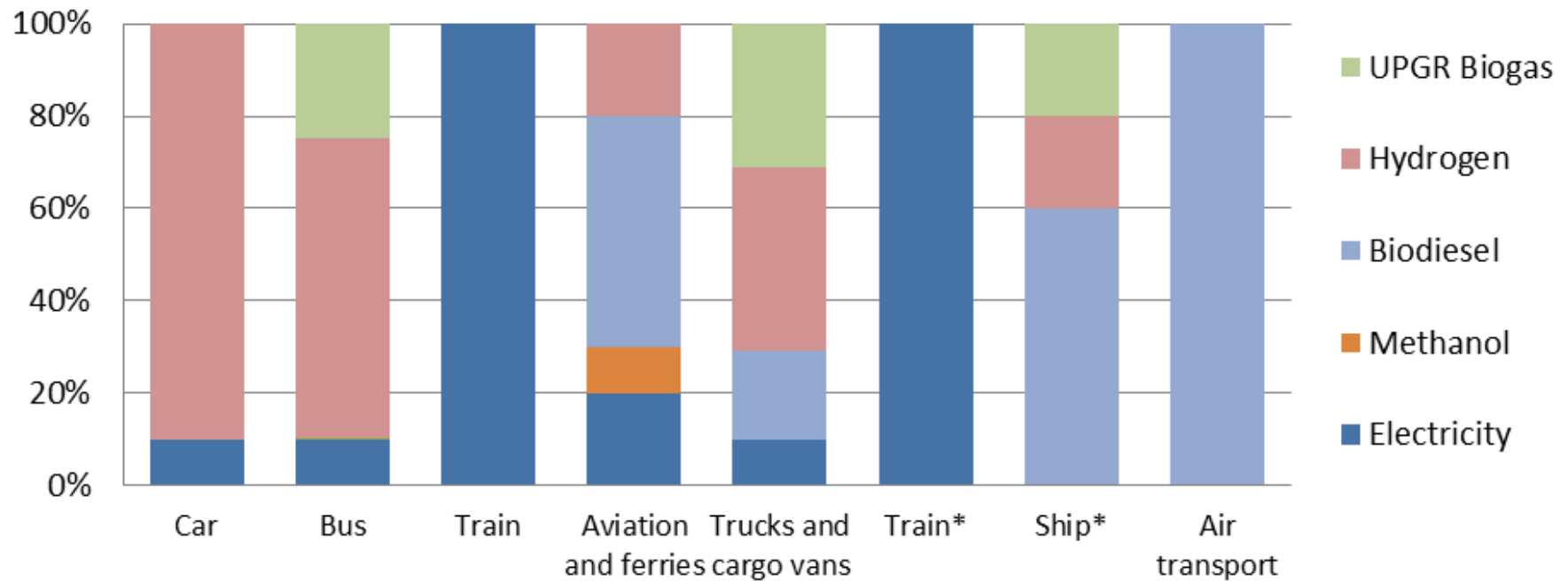
Reference - Carbon Neutral Scenario - CNS



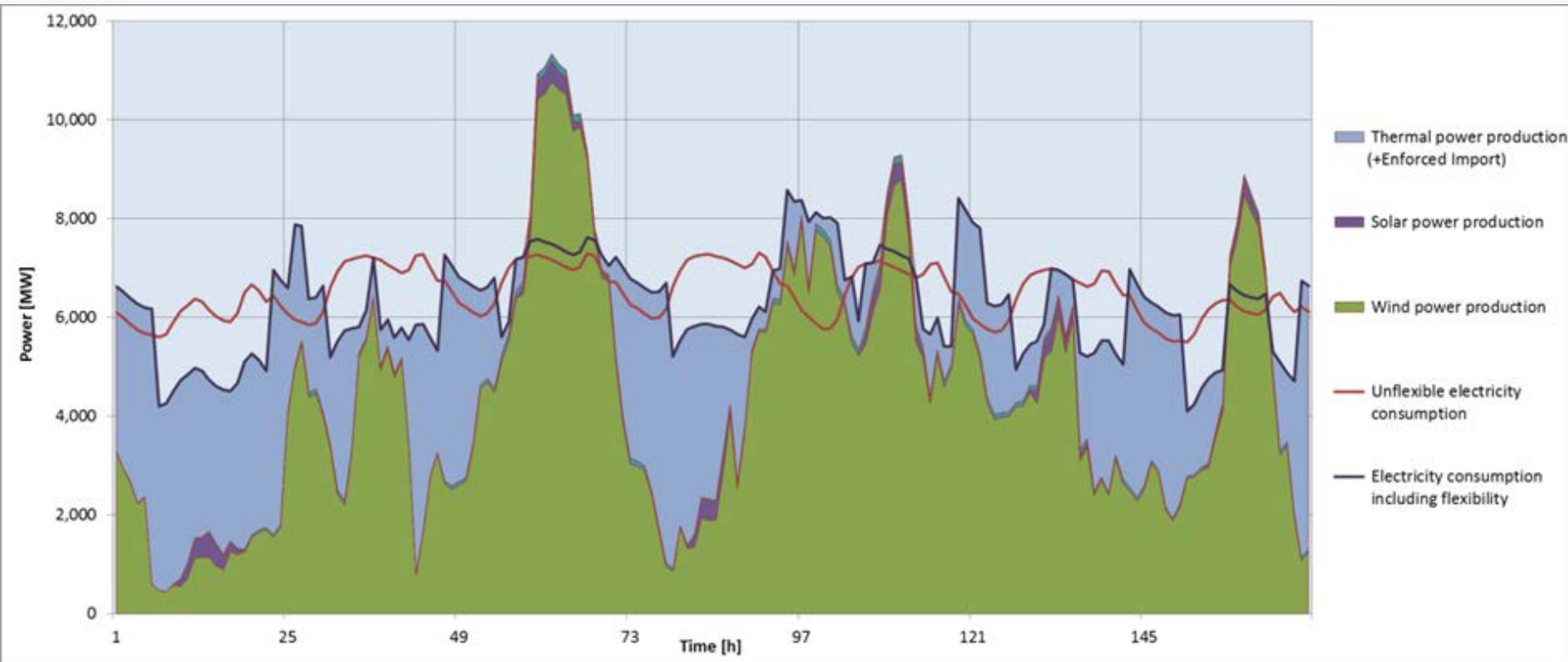
Electric Vehicles Scenario - EV



Hydrogen Scenario - H2



Scenario Results - EV

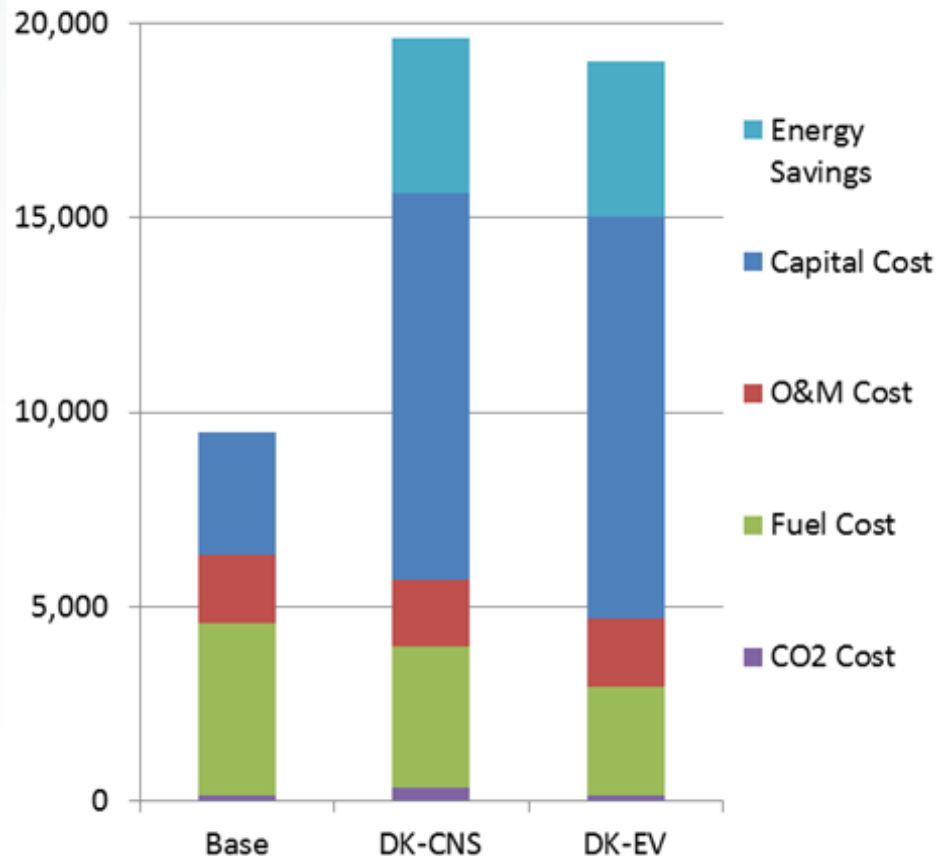


Power generation and consumption with and without flexible demand in week 10 in year 2050

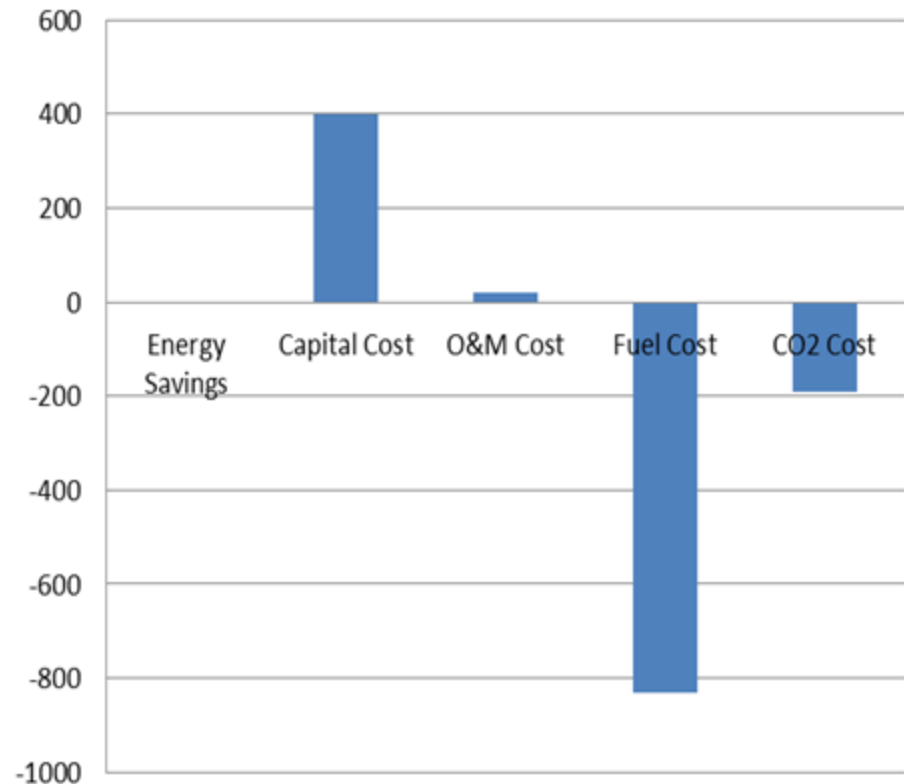


Total annual system costs and the difference between the CNS and the EV scenario (mill €)

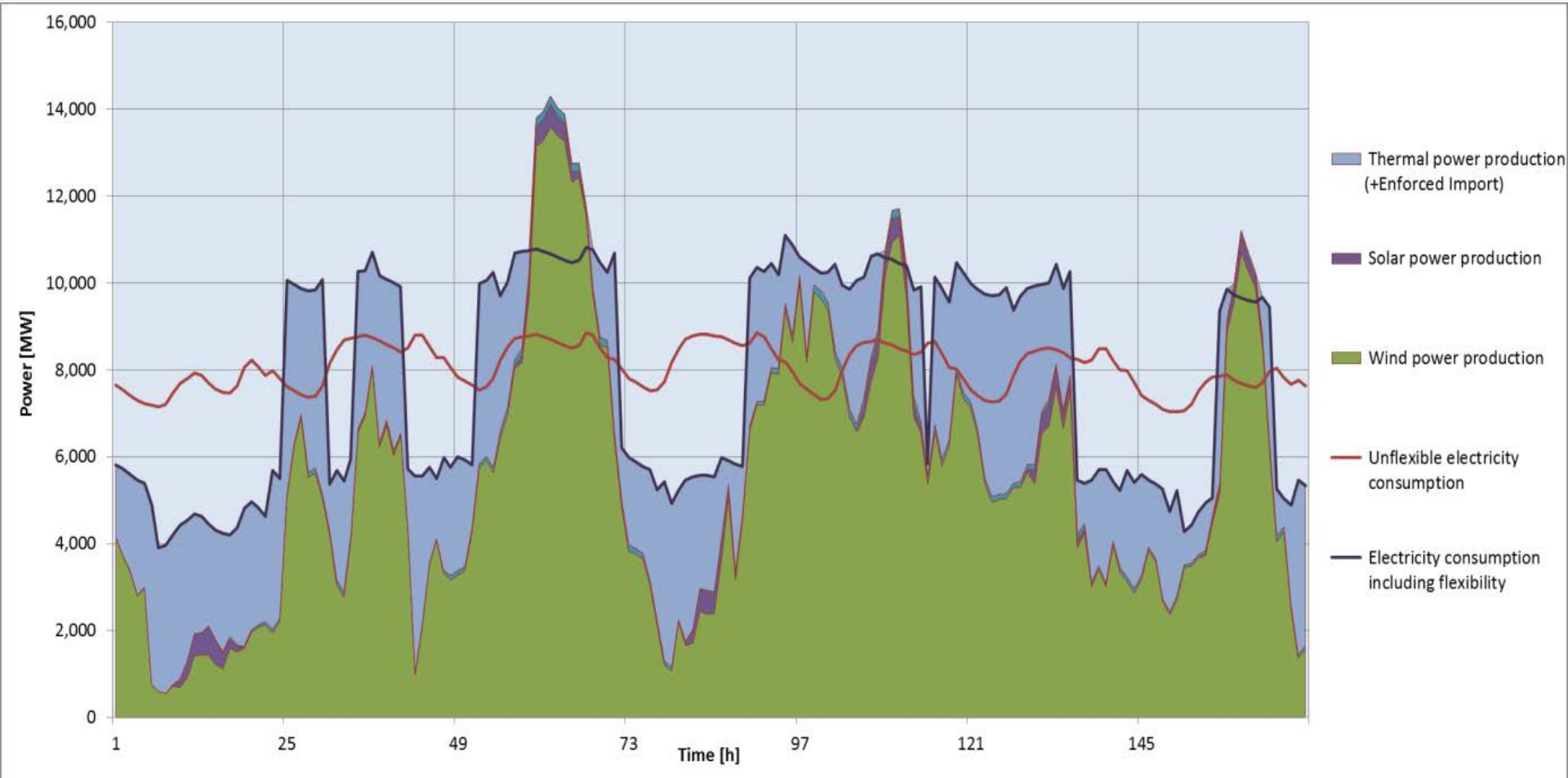
Total Annual System Cost [mill €]



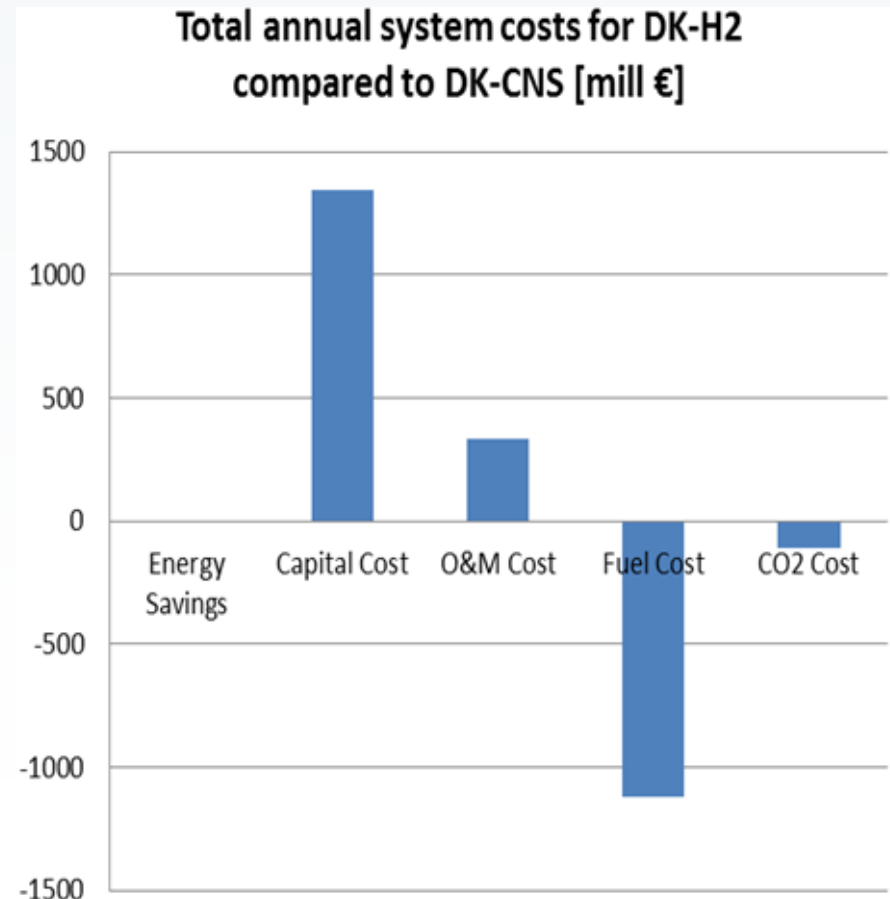
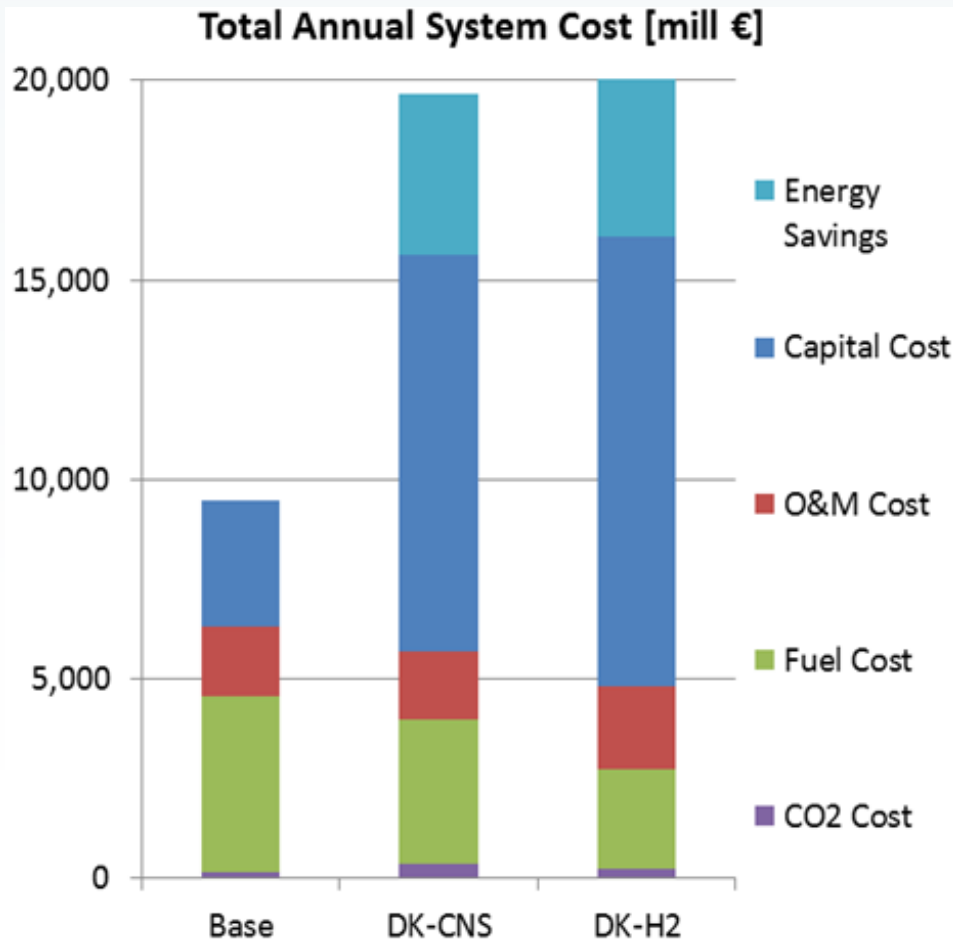
Total annual system costs for DK-EV compared to DK-CNS [mill €]



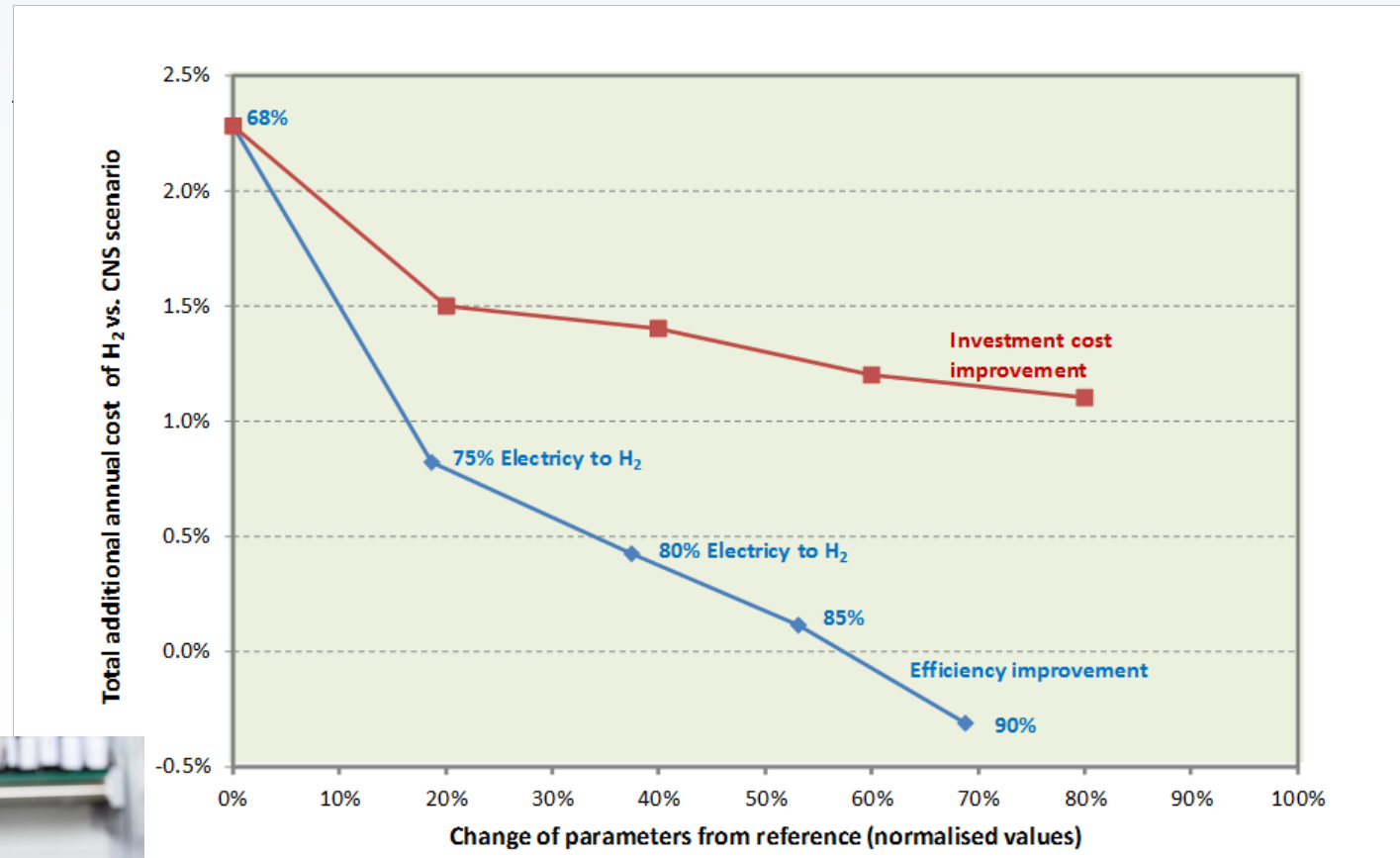
Scenario Results - H2



Annual system costs and the difference between the CNS and the H2 scenario (mill €)



Innovation and technological path - H2



Main findings

- EV could reduce the socio-economic cost of the system in 2050
- H₂ generation from electrolysis is more flexible
- H₂ production may generate heat
- A higher efficiency in the H₂ production is more important than a lower level of the capital cost
 - major driver of a successful H₂ scenario is a high efficient and flexible H₂ production in 2050
 - from a socio-economic view point: the technological path in innovation should have efficiency as its main driver towards 2050.



Thank you for your interest

Questions ?



APPENDIX

